the value $T=1.00$ (according to Linke); here 1.932 calories per minute per square centimeter is taken as the solar constant and also for the purpose of calculating the turbidity factor T.

Solar radiation, Arosa, Switzerland

Date	Hour	Elevation of sun (h)	Vapor pressure, mm. (e)	Relative humidity, per cent ($r.\ F.$)	Radiation intensity, cal. min. cm². Value observed (J')	Radiation intensity, cal. min. cm². Value for T=1.00 (J)	Turbidity factor (T)
1928		°					
Feb. 21	11:01 a. m.	30.8	(1.6)	31	1.59	1.64	1.17
Feb. 21	11:52 a. m.	32.2			1.59	1.65	1.21
Mar. 17	12:04 p. m.	41.9	(1.4)	30	1.61	1.68	1.28
Mar. 18	11:44 a. m.	42.1	1.4	24	1.63	1.68	1.20
Mar. 19	12:03 p. m.	42.6	2.0	32	1.59	1.68	1.37

Until now the value of 1.63 calories was vouched for only at elevations above 3,000 meters. The turbidity of the air, especially in so far as relates to the dates given above, was very moderate; the normal March values of T are as follows: Arosa, 1.5; Davos, 1.8; Potsdam, 2.2; and Frankfort on the Main, 3.5. At 1.4 mm. the determinative water vapor content was very low; in good agreement with this was the value $e=1.5$ mm. at Arosa at the minimum of the turbidity factor, $T=1.13$, on the midwinter date of January 15, 1925. Even in case the values $J-J'$ for the forenoon of March 18, 1928, are extrapolated to vacuous space there results no necessity of a cause for the high radiation values outside of the high transmissiveness of the atmosphere.

Does a higher value of the solar constant play a rôle in the marked solar activity? Whatever may be the case, it will be interesting to await values for the spring of this year obtained at other points and especially Abbot's values for the solar constant.[2]—*Translated by W. W. Reed.*

GROWTH OF TREES IN THE FOREST OF DEAN IN RELATION TO RAINFALL

[Reprinted from Meteorological Magazine, March, 1928]

Mr. E. G. Burtt has kindly supplied several series of measurements of the annual rings of growth of trees in the Forest of Dean. The best and longest series was given by a yew, which grew on a southwest slope overlooking Lower Sondley. The tree was cut in the winter of 1922–23, and proved to be 200 years old. The individual measurements are given in Table 1, and smoothed values constructed by taking overlapping five yearly totals are shown in the uppermost curve of Figure 1. It will be seen that the tree grew very slowly at the beginning and end of its existence and more rapidly in middle age. There are four periods of most rapid growth; the first and most important occurred from about 1780 to 1800, with a maximum from 1786 to 1792, and the second reached its maximum in 1829 to 1830. The third maximum extended from about 1861 to 1878, but is not very striking; on the other hand, the fourth maximum, which comes at 1899 to 1900, is remarkably sharp and definite. It will be noticed that the lengths of the intervals between these maxima, about 40, 40, and 30 years respectively, give an average of 36–37 years, which is very near that assigned to the Brückner cycle.

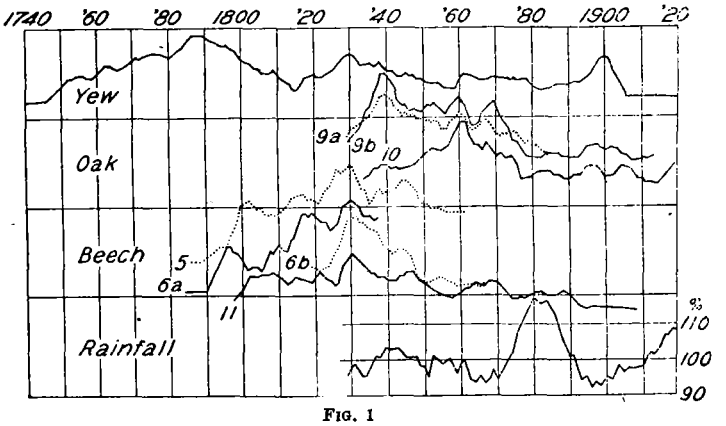

FIG. 1

Measurements of two oak trees are given, both of which grew on Staple Edge Hill and were cut about 1921. The individual measurements are not reproduced here, but the figures smoothed by forming five-yearly totals are shown in Figure 1. Curves 9A and 9B are from measurements taken at right angles on the same tree—an exceptionally well formed root—9A being along a line due west from the center and 9B along a line due north. An attempt had been made at some time to burn the stump, and the outer 40 mm., representing about 42 years' growth, were charred. It will be noticed that from 1830 to 1864 the tree grew somewhat more rapidly on the west than on the north side, but that from 1864 to 1883 this condition was reversed, growth being more rapid on the north side of the trunk. The curve labeled 10 represents the second oak tree, which showed no signs of burning. The two curves 9A and 9B are obviously closely related; No. 10 is fairly similar, but the pronounced maximum just before 1840 is barely represented, and the period of most rapid growth occurred instead about 1860. The most curious point is that these records of oak trees show very little similarity with that of the yew which grew only a short distance away. This is partly due to the much lesser age of the oaks, not one of which was 100 years old, so that the period of slow growth at the beginning of their existence coincides with the full maturity of the yew, and in fact with one of its periods of maximum. It is only when we examine the curves in detail that we can see points of resemblance, in particular the rapid increase of growth rate about 1860 and the general slow growth from 1880 to 1893. There is a distinct suggestion that the oaks responded more rapidly to changes of weather than the yew, for the curves 9 and 10 are far more irregular than the uppermost curve. The pronounced maximum at 1900 on the latter shows itself as a double maximum on both oak trees, and similarly the small minimum of 1865 on the curve for the yew becomes much more important in the oaks.

[2] Fortunately the Astrophysical Observatory of the Smithsonian Institution has already contributed the solar constant values for the dates in question to the Weather Bureau for publication on the Daily Weather Maps. The values are as follows:

Feb. 21 ..... 1.939 satisfactory minus.
Mar. 17 ..... 1.923 satisfactory minus.
Mar. 18 ..... 1.944 satisfactory minus.
Mar. 19 ..... 1.956 satisfactory minus.

—*Ed.*

TABLE 1.—*Growth of yew tree in millimeters*

Years	0	1	2	3	4	5	6	7	8	9
1740				1.0	1.0	1.0	1.0	1.0	2.0	2.0
1750	2.0	2.0	2.0	3.0	2.0	2.5	2.5	2.0	2.0	2.5
1760	2.5	3.5	3.5	3.0	2.0	2.5	3.0	3.0	4.0	3.0
1770	3.0	3.0	4.0	3.0	4.0	3.5	3.5	4.0	3.0	3.5
1780	3.5	3.0	4.0	4.5	4.0	4.5	5.0	4.5	5.0	4.0
1790	4.5	4.5	3.5	4.5	3.5	4.0	4.5	4.0	3.0	3.0
1800	3.0	3.0	3.5	2.5	2.5	2.0	3.0	2.5	2.5	2.5
1810	3.0	2.0	1.5	1.0	2.0	1.5	1.5	3.0	3.0	2.5
1820	2.0	2.0	2.0	3.0	3.0	2.5	3.0	3.5	4.0	4.0
1830	3.0	3.0	3.0	3.0	2.5	3.0	3.5	3.0	2.5	3.5
1840	2.0	2.0	3.0	2.0	2.5	2.0	2.5	2.5	2.0	2.0
1850	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.5	2.0	2.0
1860	2.5	3.0	3.0	1.5	2.0	2.0	2.5	2.5	2.0	2.0
1870	3.0	2.0	2.5	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1880	2.0	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.0	2.0
1890	2.0	2.0	2.5	2.0	2.0	2.5	3.0	3.5	4.0	4.0
1900	3.5	3.0	3.0							

Total growth 1823–1732, 8 mm., 1733–1742, 9 mm.
Total growth 1903–1912, 14 mm., 1913–1922, 14 mm.

Of the beech trees, Nos. 5 and 6 grew on the Blaize Bailey ridge and No. 11 grew near the yew tree; the dates of felling are not known, but were probably between 1900 and 1910. The two records 6A and 6B are from measurements along two lines at right angles on the same tree, but the actual directions are not specified. Since the dates of felling were not known exactly, it was necessary to fit the curves together from intrinsic evidence only. This was not difficult so long as only the three beech trees were considered; the correlation actually adopted seems to be the only possible one. When it came to fixing the age of the trees absolutely, by reference to the yew and oaks of which the dates of felling are known, it was a different matter, and the dating adopted in drawing Figure 1 is to be regarded as something of a guess. Like the oaks and the yew, the beech trees grew slowly at the beginning and end of their existence, while the response to changes of climate seems to have been more rapid than that of the yew, but perhaps not quite so rapid as that of the oaks.

For comparison between the rate of tree-growth and the amount of rainfall, Dr. J. Glasspoole has been good enough to calculate a series of rainfall values for the Forest of Dean extending from 1820 to 1920, expressed as a percentage of the normal for the 35 years 1881 to 1915. A comparison of these figures with the annual growths of the yew in Table 1 shows that there is little if any relation between the growth in any one year and the rainfall in that year. When we smooth the data over a number of years, there are some indications that heavy rainfall is inimical to the growth of the yew, but with the oak and the beech the relation is still indefinite. The rainfall data, smoothed by forming overlapping 10-year means, are shown in the lowest curve of Figure 1; following the model of the well-known American investigations into the relation between tree-growth and rainfall the curve has been shifted to the left, in order to compare the tree growth in any year with the rainfall during the previous 10 years. Thus the point where the rainfall curve crosses the vertical line for 1830 shows the rainfall of the years 1821 to 1830, which was 98 per cent of normal.

TABLE 2.—*Comparison of growth of yew tree with rainfall*

	1826–1835	1836–1845	1846–1855	1856–1865	1866–1875	1876–1885	1886–1895	1896–1905	1906–1915
Tree growth, mm..	32	26	21	20.5	23	19	21	28	(14)
	1820–1829	1830–1839	1840–1849	1850–1859	1860–1869	1870–1879	1880–1889	1890–1899	1900–1909
Rainfall, per cent...	95	104	98	96	98	114	102.5	92.5	98

The period of rather rapid growth of the yew about 1830 comes at a time when the rainfall curve is low, but the minimum from 1851 to 1859 follows the maximum of the rainfall curve by about 10 years. The poorly developed period of maximum growth from 1861 to 1870 fits in fairly well with the minimum of the same years on the rainfall curve, but the outstanding maximum shown by the latter about 1880 to 1883 is only represented by a slight minimum on the curve of tree-growth. On the other hand the pronounced maximum growth about 1900 agrees very well with the minimum on the rainfall curve. The opposition is also shown in Table 2, where the total growth of the yew in successive periods of 10 years is compared with the rainfall 6 years earlier. The most notable feature of this table is that, excluding the years 1906 to 1915, when the slow growth of the tree may be attributed to old age, the slowest growth, 19 millimeters in 1876 to 1885, corresponds with the decade 1870 to 1879, which was by far the rainiest, while the two periods of most rapid growth, 1826 to 1835 and 1896 to 1905, correspond with the two decades of least rainfall. There are no available records for the Forest of Dean previous to 1820, and a comparison of the growth of the yew from 1750 to 1820 with Doctor Glasspoole's figures for the whole of England, published in the *Meteorological Magazine* for February, failed to show any definite relationship. If the hypothesis that the yew grew best in dry weather is correct, we should infer that in the Forest of Dean the years 1803 to 1813 were rainy and the years 1780 to 1790 dry; it would be interesting to know if local non-instrumental records confirm or disprove this. The general results of the comparison are not very convincing, however, and do not make it probable that we shall ever be able to write the history of our rainfall from the rings of our trees, as has been done so successfully in the west of America, even if we can find trees of sufficient age.